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About the Cover

The Atlas-Centaur-66 carrying the FLTSATCOM-F7 communications satellite was launched into the night sky December 4, 1986 at 9:30 p.m. EST from Cape Canaveral Air Force Station. The Atlas launch went without any problems and brought NASA another step closer to getting back in space.

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Dwayne C. Brown
Editor, Code LFD-2
NASA Headquarters
Washington, D.C. 20546
Phone: (202) 453-8400

Administrator's Column

(In this column NASA Activities features an article by NASA Administrator James C. Fletcher. These articles focus on subjects that address topics of broad interest to the agency's employees. This column features an address presented to the 1986 NASA Symposium on Quality and Productivity, Washington, D.C.)

We appreciate the cooperation of the American Institute of Aeronautics and Astronautics in helping to put this event together and we commend the many experts in government, industry and academia who helped to plan it.

More than two years ago, NASA held its first symposium of this kind. Our idea then was to help awaken the nation to the importance of productivity and quality to our society. I am pleased that our efforts increased national awareness of productivity and quality problems and encouraged government and industry to work to solve them. We expect this conference to be equally productive, as we work to realize the goal we all share: to strengthen the American economy and our competitiveness in the world.

Today and tomorrow, we will be talking about ways to work even harder to revitalize our organizations and our technological and industrial base.

Clearly, we need to work harder, as individuals, as teams, as organizations and as a nation if we are to outpace our competitors and keep America on the road to progress and prosperity in the years ahead. For, as we all know, productivity growth is essential to maintain our high standard of living and our nation's economic stability and progress.

One of the major problems we pinpointed at our last conference was the fact that over the years, the government-industrial complex has developed an overhead structure that hinders productivity. This structure involves a bewildering interplay of Congressional actions and the interaction of many governmental organizations, independent pressure groups and the integrity and attitudes of the industrial community.

The government-industrial complex has become a major factor in affecting our competitiveness in the world. While we seem to be making some progress in tackling this problem, much more needs to be done. It is essential that each of us continue to make the effort because our ultimate success depends on it.

At NASA, we are committed to work with our industry partners and supporters in a non-adversarial relationship. We will continue to examine our procedures and policies to foster improved efficiency, while maintaining adequate controls. For its part, industry must ensure that waste, fraud and mismanagement do not become factors in hindering that relationship.

I would like to share some thoughts on NASA's efforts to increase productivity and quality. We are proud of those efforts. Productivity and quality are inexorably linked, because they boil down to how effective we are in using our people, funding, equipment and facilities to do our job.

While some work is proceeding within NASA, particularly to motivate our people to perform up to their highest potential, it is *outside* of NASA that our productivity efforts have been of greatest benefit to industry and to the general economy. Those efforts are focused in two areas.

The first is through the NASA Technology Utilization Program, a pioneering government-industry technology transfer program which most of you are familiar with. The Technology Utilization Program benefits the economy through the applications and spin-offs of aerospace research and technology.

The second effort is through our contractors.

As you know, NASA differs from most government agencies in two major respects: it has a very visible and exciting mission that enjoys a high degree of public support and it also shares most of its funding with contractors in the private sector. As I said earlier, one of NASA's highest priorities is to work with its contractors, not as adversaries, but as partners, to inspire the highest standards of service and product performance.

There are countless examples of NASA/Contractor productivity initiatives, and we all are very proud of them. They not only have saved millions of taxpayer dollars, but have enabled us to do what we do more efficiently and effectively. Let me give you just two examples.

First, in cooperation with the NASA Marshall Space Flight Center, Martin Marietta Aerospace developed and implemented a new technique for welding the Shuttle's external fuel tank.

That technique, called Variable Polarity Plasma Arc Welding, not only improved basic productivity of the external tank, but also the quality of its hardware. This and other productivity initiatives have already saved the taxpayers $28.2 million by achieving a 45 per cent decrease in the cost of producing ther tanks.

The second example was implemented at the Kennedy Space Center, where safety regulations forbid certain activities involving explosive materials or devices during electrical storms. Here we found that fueling operations could continue safely at Launch Complex 39A during thunderstorm warning periods by applying lightning control techniques developed by Planning Research Corporation to the fuel storage areas. The results will increase productivity and are expected to save $1 million a year.

Other examples of NASA/Contractor productivity and quality initiatives focus on such areas as improvements in systems, energy utilization and the workplace environment. Taken together, they reflect a rededication to the spirit of excellence that has been a hallmark of the NASA team for nearly three decades.

As you know, economic theory requires that increasing national output depends on three factors: the size of the labor force; the amount of capital investment; and a factor called "technical change." The increase in national output for a given work force is a measure of productivity. This requires not only innovative ideas and a dedicated and motivated work force, it also requires attention to new technology and its appropriate transfer to the private sector. Here, we in NASA play in important role by providing a mechanism by which innovation can generate the new industries, products, processes and jobs that make the economy grow and prosper.

One NASA program that has provided that mechanism for the American economy for more than 20 years is the Technology Utilization program I mentioned earlier.

Under the NASA program, research conducted at the NASA research centers is made available to private industry for aerospace and non-aerospace applications. I have already mentioned the use of variable polarity plasma arc welding, which will have extensive applications in large-scale manufacturing. Similarly, the metallurgical improvements in the Space Shuttle Main Engine eventually will find many other commercial and military applications.

Let me give you some other examples, which have already flowed into the economy.

Recently, through its TU Division, NASA licensed several companies to manufacture portable low-intensity x-ray imaging scopes called lixascopes. The lixascope resulted from efforts of NASA's Goddard Space Flight Center to improve its abilities to conduct x-ray astronomy. Because the device reduces the dosage of radiation required in any given operation, the medical electronic industry believes it has

Athletes may benefit greatly from lixascopes

an excellent potential for improving safety in radiography. Indeed, one licensee has already patented and is preparing to market a fluoroscope system utilizing the lixascope for intra-operative x-ray procedures.

By the same token, over the years, American automobile manufacturers have drawn upon NASA research in advanced materials technologies to help develop ceramic and composite materials applications for cars.

Today, tens of thousands of applications and spin-offs of NASA research enhance our lives in a variety of areas, ranging from traffic control and highway safety systems to smoke detectors.

It has been estimated that in medicine alone, some 12,000 life-saving devices and processes were born from aerospace research. These include programmable heart pacemakers and other programmable implantable systems that dispense medication, alleviate pain and control blood pressure; surgical tools; and devices used by paralyzed individuals in the emerging field of computer-controlled walking.

Clearly, if we are going to be leaders in productivity, and maintain our nation's technological leadership, the United States must continue to devote adequate resources and attention to our research and development efforts, both in government and in industry.

The Challenger accident highlights still another, most important productivity issue, and one that is not normally addressed. And that is the management of risk.

At first, NASA didn't consider the accident as a productivity problem. But, in retrospect, it is clear that it has become part of the larger issue of productivity of the Space Transportation System as a whole. The accident had a significant, even critical impact

on the system's productivity because it disrupted our production lines, set back our timetables and the timetables of many others, and affected the morale of our people. And, even though NASA is on the move again and is rededicated and motivated to getting the space program back on track, there is no denying that the Challenger accident will affect the STS system's productivity for some time.

The Challenger accident is not unlike the accidents at Three Mile Island, Bhopal and Chernobyl. In all those cases, complex systems reacted abnormally and had to be properly managed. When they were not, the consequences were catastrophic.

Risk management involves many factors, beginning with design and moving through production and inspection. In the final analysis, it requires us to address both the reliability of the machine and the competence and judgment of experienced people.

The lesson of Challenger, of Chernobyl and of Three Mile Island is a hard one, and it is this: We are living in an age where the single biggest factor affecting productivity may be our ability to properly manage technical risks. And the organizations and nations that can best manage to control those risks are the ones that are going to win the productivity race.

Managing product reliability and managing people to enable them to do their best — these are our key challenges in this increasingly competitive, increasingly technological world.

Since the beginnings of our Republic, our nation took great pride in the quality of the products we produced. Today, many believe we have lost that pride. Whatever the case, we must prove to the world once again that we are the leaders in both technology and quality.

The place to start is here. And the time to start is now.

NASA Produces Major Power Improvements With Jet Engine Program

Need to get a jet fighter up to 40,000 feet thirty seconds faster? That could require developing a new engine with all its attendant costs. However, a new engine control system, developed by NASA, squeezes unused power out of present jet engines to offer major thrust and fuel economy advantages.

Using newly developed engine/flight control integration technology, researchers at NASA's Ames-Dryden Flight Research Facility, Edwards, Calif., have been demonstrating increased thrust of 10 percent or more with its F-15 research aircraft. Flight tests have shown fuel savings exceeding five and up to seven percent in some types of flight. The increased performance has been accomplished with only one of the two F-15 engines modified.

The engine and flight control integration technology necessary for such jumps in performance are a result of NASA's Highly Integrated Digital Electronic Control program (HIDEC). HIDEC trades unneeded engine stall margin for increased performance (stall margin is the amount that engine operating pressure must be reduced to avoid stall). HIDEC is being conducted in conjunction with the Air Force, McDonnell Aircraft Co., and Pratt and Whitney.

HIDEC technology will increase aircraft performance immensely

Several factors add to the typical 25 percent stall margin required by a jet engine, which often reduces an engine's usable power by almost 15 percent. This is necessary with conventional engines because designers have to allow for the worst combination of flight conditions in which aircraft fly.

The HIDEC system allows the engine to adjust or trim itself to the minimal stall margin in any case. Situations such as inlet flow disturbances, afterburner use and a remaining "insurance pad" or margin are compensated for and adjustments also are made dependent on actual flight conditions rather than being assumed constant.

HIDEC drops the stall margin requirement down to about 12 percent, still allowing for variations in engines, control tolerances, air density variations, inlet flow disturbances and a four percent pad.

The key to such performance increases is an engine and flight control system that communicate with each other. The NASA/McDonnell F-15 is equipped with one Pratt & Whitney 1128 research engine with digital electronic engine control and a standard F-100

engine. In addition, the F-15 is modified with a digital electronic flight control system.

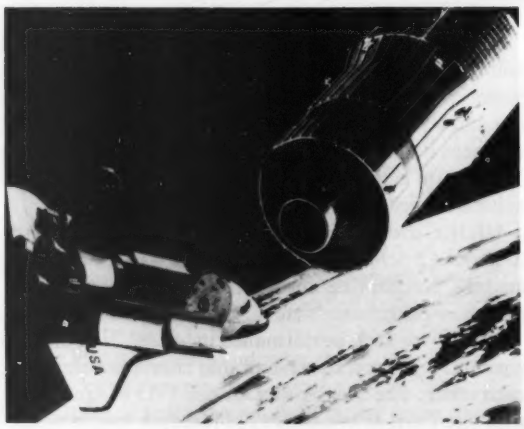
The HIDEC combines the engine control and flight control systems. Flight condition information such as attitudes, rates and pilot commands are provided to the HIDEC and analyzed. In addition, the HIDEC system anticipates flight conditions in advance to select the minimum margin required for that instant of flight. The appropriate commands are then made to the digital engine control system which adjusts the engine nozzle to provide the correct operating pressure.

NASA Ames-Dryden project manager Dr. James F. Stewart characterizes HIDEC program accomplishments as major and expects HIDEC to be found on the fighter aircraft of the 1990's. "The single-engine program has been virtually problem free, very fruitful and the numbers are better than predicted."

Upper Stage Selected For Planetary Missions

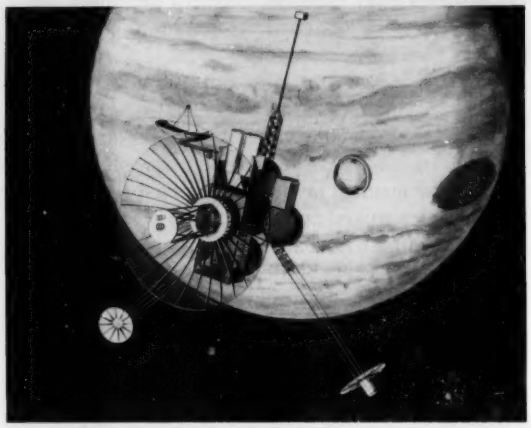
NASA selected the Inertial Upper Stage (IUS), a launch vehicle which fits in the cargo bay of the Space Shuttle as the baseline option to carry probes to Jupiter, Venus and the sun. However, an option is being kept open until early this year to fly one of these missions on a Titan IV.

NASA Administrator James C. Fletcher selected the upper stage, built by the Boeing Aerospace Co. under Air force contract, for three planetary missions — Galileo, Magellan and Ulysses — to be launched in 1989 and 1990. These missions will be the first to employ an IUS to carry payloads to study other bodies in the solar system.



The IUS as it would look deployed from the Shuttle

Each of the planetary payloads will use a standard two-stage IUS, with the exception of Ulysses — a probe to study the poles of the sun — which will require the addition of a Payload Assist Module, built by McDonnell Douglas Astronautics Co. The added module, a smaller "kick" stage, will be needed for additional energy to reach proper orbit around the sun.



Galileo consists of a probe and orbiter

Ulysses is a joint mission of NASA and the European Space Agency (ESA). ESA funded and built the Ulysses spacecraft which will have on board several American scientific instruments.

The IUS is a two-stage, 17-foot-long vehicle weighing more than 16 tons. It has already been employed to carry payloads to geostationary orbit — where satellites match the turning of the Earth and appear unmoving in the sky — although it has always been designed for both Earth-orbital and planetary missions.

The Magellan mission will orbit Venus and map its surface with radar, since the cloud cover of the planet obscures direct vision.

Galileo will orbit Jupiter for nearly 2 years to measure such things as electromagnetic fields and plasma particles. The orbiting spacecraft also will send down an atmospheric probe for on-site readings, although the probe is expected to last for no more than a few hours because of the intense atmospheric pressure. Galileo is a joint mission of NASA and Germany, which developed the retropropulsion system for the probe's descent into the Jovian atmosphere.

The study of the solar poles by Ulysses will be the first time in the history of the space program for such an area to be investigated.

The Magellan, Galileo and Ulysses missions are managed by NASA's Jet Propulsion Laboratory, Pasadena, Calif. The IUS and payload-to-IUS integration for the planetary missions will be managed for NASA missions by the agency's Marshall Space Flight Center, Huntsville, Ala.

In August 1986 a Commerce Business Daily announcement gave notice of a proposed NASA action to study alternative launch vehicles for planetary missions following cancellation of the Shuttle/Centaur Upper Stage. Because of an urgent and compelling need to reestablish NASA's planetary program following the Challenger accident, the space agency concluded that IUS had the unique capability to meet the mission requirements.

NASA Scientists Employ Satellites To Map The Ocean Floor

If there were no winds, waves or currents, the world's oceans might appear very calm and flat. However, oceans have their own hills and valleys, similar to those on land, according to Dr. James Marsh, a geophysicist at NASA's Goddard Space Flight Center, Greenbelt, Md.

"Think of ocean surfaces as if they were blankets thrown over rugged terrain. The force of gravity pulls water down into the depressions or forces it up around the mountains, causing gentle hills and valleys on the water's surface," said Dr. Marsh. He added that ocean surfaces are so uneven that looking north from Puerto Rico toward Bermuda, one could see the ocean surface drop nearly 60 feet over a distance of almost 30 miles.

A map generated by Marsh and his co-workers, using data obtained from the altimeters of the Geodynamic Experimental Ocean Satellite (GEOS-3) and the Sea Satellite (SEASAT), shows the true topography of the Earth's ocean surfaces in greater detail and more accurately than ever before. The GEOS-3 and SEASAT measured the distance from space to the ocean surface with radar. The radar-generated data then was used to develop a computer image of the surface of the world's oceans.

Marsh said, "The altimeter data allowed us to measure profiles of the ocean surface. By putting together many profiles, we were able to compute a map of its true shape. The map reflects what the Earth's structure is like under the ocean. If we can understand the underlying crustal structure, it'll give us information on other important phenomena, such as earthquakes and volcanoes."

He continued, "The data generated by GEOS-3 and SEASAT also increased our knowledge of ocean circulation and current systems. The spacecraft's altimeters allowed us to detect and study features 1 to 2 meters in height."

Marsh believes the success of these experiments led to the development of the Ocean Topography Experiment satellite (TOPEX/Poseidon), a NASA/CNES (the French Space Agency) joint venture, planned for launch in 1991.

The altimeters on board future oceanographic satellites, such as TOPEX/Poseidon, will be so accurate they will enable scientists to observe most of the world's ocean surface currents.

Marsh concluded, "The ocean is a major means for transporting heat around the Earth. TOPEX/Poseidon will help us study ocean currents and their circulation and how they influence the world's weather patterns."

Remote Sensing Will Help Predict Changes In Soil Conditions

Satellites combined with computer technology are throwing a "one-two punch" to better understand the importance of soil within the total ecosystem.

A computer simulation model of the properties and processes in the soil can be combined with satellite data of the Earth's surface to predict changes that occur in soils over a period of time, and also, the ability of the soil to support different types of plant life.

The theory was advanced by Dr. Elissa Levine, a physical scientist at NASA's Goddard Space Flight Center, Greenbelt, Md., during an annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, in New Orleans. Her observations are contained in her conference report, "Modeling Soil Processes with the Use of Remote Sensing".

"By combining the soil simulation model and remote sensing (via satellite and aircraft), we can obtain critical environmental data which will help us understand how changes brought about by both nature and humankind will affect the total ecosystem over time," according to Dr. Levine.

By linking surface conditions to processes occurring underground, the soil system makes invaluable contributions to our environment.

"Characteristics of a given soil determine its ability to perform important functions including supplying

nutrients, water and mechanical support for plant growth, recycling organic materials needed to supply nutrients and filtering wastes and pollutants before they reach ground water," she said. Levine and her colleagues say these functions also help to maintain aquatic life and drinking water.

Scientists believe that soils change slowly in response to management or changes in their environment. However, it is difficult to determine the effects of today's environmental activities on soils — such as acid rain increases in atmospheric carbon dioxide, decrease in atmospheric ozone or agricultural practices — or how soil helps to offset these activities without extensive experimental sampling in the field.

Levine said that answers concerning the effects and remedies of these and other environmental problems must be obtained quickly. Long-term field experiments would take too long to set up and carry out. She concluded, "The computer-satellite combination provides scientists with a quick and accurate collection of data about the soil and the Earth's surface without depending on field measurements which may be difficult to acquire."

Four Great Observatories Will Aid In Astronomical Explorations

Almost everyone is curious about the universe. Although mankind has studied astronomy since ancient times, many aspects of the universe remain mysterious. Our understanding of the universe no longer depends on preconceptions but on precise observations and measurements. The advance of spaceflight has made possible the placing of sensitive astronomical instruments into space.

We now have the advanced technology needed to place entire observatories into space for investigations across the spectrum and thereby open a new era of space observations.

Astronomical observations pose some of the greatest challenges of modern technology. During the past two decades, NASA has continued to develop and place into orbit, increasingly sensitive instruments to observe the universe with improved sensitivity. With the development of the four great observatories, we now have technology for the future.

A new generation of space observatories offer new gains of sensitivity through state-of-the-art technology:

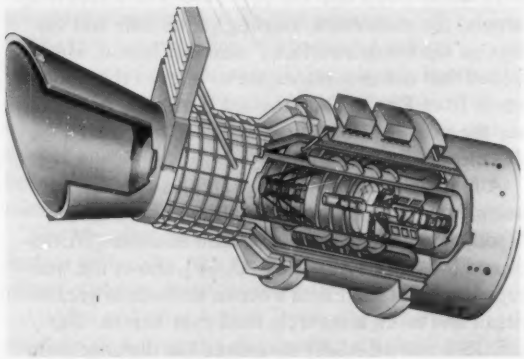
— Gamma Ray Observatory —

The Gamma Ray Observatory (GRO) will explore

the most energetic part of the spectrum across a much greater wavelength range than earlier observatories. The GRO will enable us to determine if most of the known gamma radiation arriving from the universe originates in quasars and pulsars, or whether there are other sources of gamma ray emission.

— Space Infrared Telescope Facility —

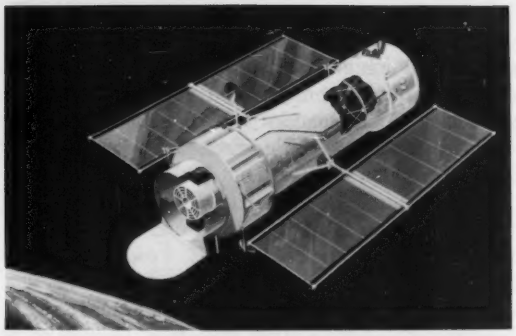
The Space Infrared Telescope Facility (SIRTF) will span the infrared part of the spectrum with a 1000-fold increase in sensitivity. SIRTF will provide a vital tool needed for detailed studies of the infrared universe. SIRTF will be able to search for planets



around the nearest stars. If planets are detected, the Search for Extraterrestrial Intelligence could be more clearly focused.

— Advanced X-Ray Astrophysics Facility —

The Advanced X-Ray Astrophysics Facility (AXAF) will cover the x-ray portion of the spectrum with a 1000-fold improvement in sensitivity. AXAF will be an international observatory for studying highly energetic environments found in nearly every known object in the universe, including stars and



planets as well as neutron stars, black holes, quasars and cores of active galaxies. With AXAF, the most distant quasars in the universe will be located and studied.

— Hubble Space Telescope —

The Hubble Space Telescope (HST), the largest telescope ever put into space, will penetrate deep into the universe in visible and ultraviolet light, expanding the volume of observable space by several hundred times more than now possible. Named for Edwin P. Hubble (1889-1953), who discovered that the boundaries of the universe extend far beyond the Milky Way, HST represents a quantum leap in sensitivity, resolution and precision.

HST has a primary mirror 2.4 meters in diameter that is esentially perfect and being operated above the Earth's atmosphere, the telescope's observations will distinguish fine details with 10 times the clarity of the best ground-based observatories. HST's five primary instruments are:

(1) A High Resolution Spectrograph, which will examine the ultraviolet region of the spectrum, seeing light which cannot reach Earth. It will detect objects 1,000 times dimmer than those observed by previous spacecraft at comparable or higher spectral resolution.

(2) The Wide Field/Planetary Camera, designed to observe relatively large fields of view, can operate in two modes. Its "wide field" capability permits the examination of large areas of space, allowing accurate plotting of the location and spatial structure of distant objects such as galaxies and quasars. It also has a high resolution, or "planetary" mode, to permit the study of planets within our solar system as well as the detailed structure of galaxies, nebulae and star clusters.

(3) The Faint Object Spectrograph can obtain spectra of extremely faint astronomical objects in ultraviolet and visible wavelengths allowing scientists to study comets before they are chemically changed by the sun and to analyze quasars thought to be at the nuclei of some galaxies.

(4) The High Speed Photometer is designed to measure the total light and its time variations from an object in space. The instrument will resolve fluctuations in brightness on a time scale down to 10 millionths of a second.

(5) The Faint Object Camera, was developed by the European Space Agency. This instrument will have the capacity to measure accurately the intensity of faint galaxies at unprecedented distances into

the universe and will see closer objects in greater detail.

HST will be placed in a 370-mile orbit. During its mission, which will extend well into the next decade, the telescope will receive in-orbit servicing by astronauts aboard the Shuttle or from crew members aboard the Space Station. NASA's Marshall Space Flight Center, Huntsville, Ala., will manage the maintenance and refurbishment program. In-orbit operation of the telescope is the responsibility of the Space Telescope Operations Control Center, at NASA's Goddard Space Flight Center, Greenbelt, Md.

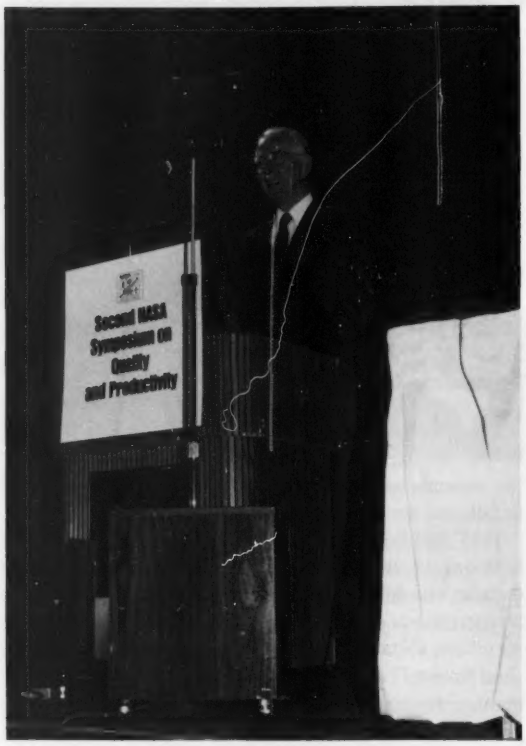
Record Attendance At NASA Productivity Symposium

On December 2-3, 1986, NASA in conjunction with the American Institute of Aeronautics and Astronautics (AIAA), conducted the Second NASA Symposium on Quality and Productivity. Over 1,100

individuals from government, industry and academia were in attendance.

The primary theme of the Symposium, Strategies for Revitalizing Organizations, provided a forum for senior leaders from industry, government, and academia to explore ways in which to increase national quality and productivity.

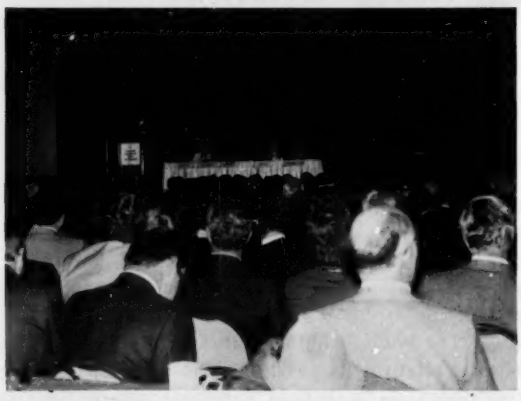
The Symposium's message underscored the importance of the recent Presidential Executive Order for productivity improvement by providing a forum for individuals and teams to explore successful



James C. Fletcher delivering the opening remarks.

approaches. NASA invited business leaders whose companies have made important accomplishments in quality and productivity improvement to share their experiences for the good of the Nation.

Participating in the workshops and interative participative groups were 45 leaders of model business companies and government agencies, whose organizations have made important accomplishments in quality enhancement and productivity improvement. They shared their experiences by discussing the symposium's four key themes: maintaining teamwork and a participative management environment; building a constant improvement philosophy and quality ethic in the organization; fostering entrepreneuralism and innovation in the middle-aged organization; and developing productivity measurement techniques and gainsharing approaches. These leaders included such notable executives as: John C. Bierwirth, Chairman and CEO, Grumman Corporation; Andrew C. Siegler, Chairman and CEO, Champion International Corporation; Robert W. Galvin, Chairman of the Board, Motorola, Inc.; Thomas G. Pownall, Chairman and CEO, Martin Marietta Corp.; Malcom T. Stamper, Vice Chairman of the Board, The Boeing Company; Dr. John S. Toll, President, University of Maryland; Donald B. Rassier, Chairman, Ford Aerospace and Communications Corp.; June M. Collier, President and CEO, National Industries, Inc.; Frederick F. Jenny, President and CEO, System Development Corporation; William R. Hoover, President and Chairman of the Board, Computer Sciences Corp.; Terence C. Golden, Administrator, General Services Administration; General John L. Piotrowski, Vice Chief of Staff, USAF; Dr. William F. Ballhaus, Jr., Director, NASA Ames Research Center, California; Richard H. Peterson, Director, NASA Langley Research Center, Virginia; and George A. Rodney, Associate Administrator for Safety, Reliability and Quality Assurance, NASA Headquarters.

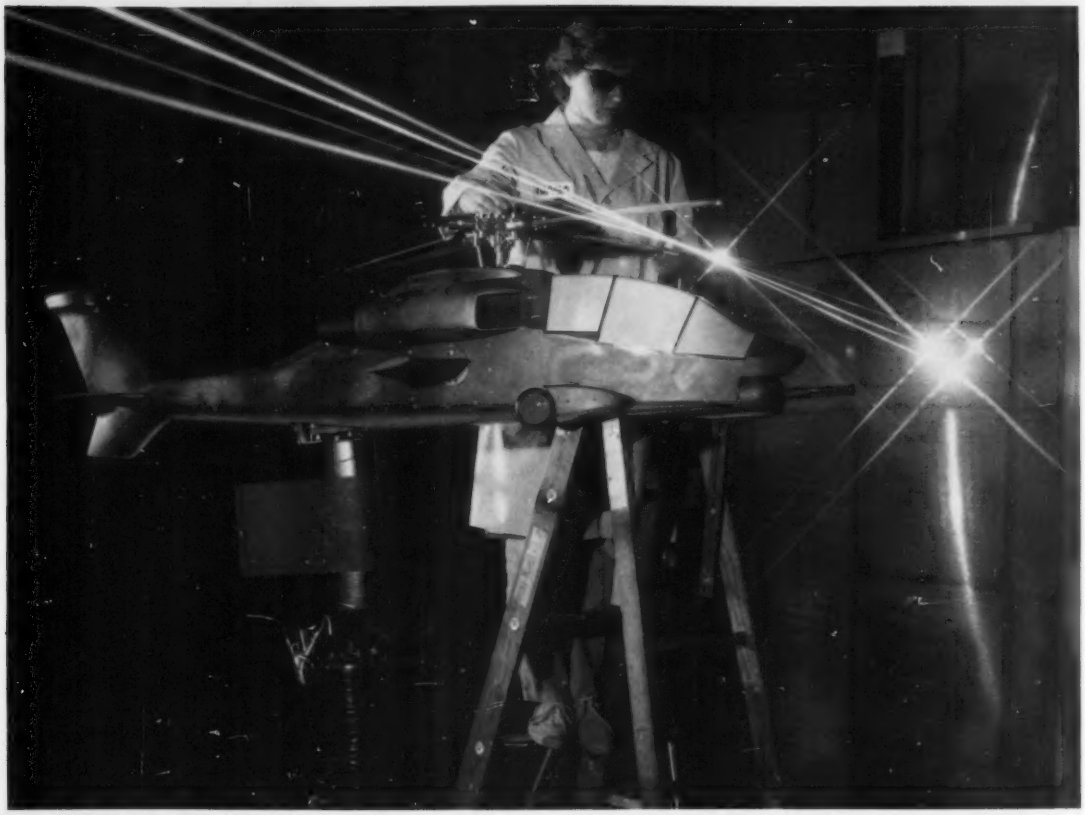


A view of the center section of the assemblage of attendees at the symposium.

Unique to this Second Symposium was the innovation of a team concept. Organizations sent management teams to participate in the belief that a team of senior executives has a greater likelihood of networking and executing initiatives that will have a lasting impact on their respective organizations.

Another innovative feature of the symposium was the institution of eight interactive sessions designed to get people involved and promote the exchange of ideas.

The NASA co-chair of the symposium was Joyce R. Jarrett, Acting Director of the NASA Productivity Programs Office, and the industry co-chair was David R. Braunstein, Director of Productivity, Douglas Aircraft Company, Long Beach, California. NASA Administrator James C. Fletcher welcomed the attendees and the Deputy Director of The Office of Management and Budget, Joseph R. Wright, Jr., gave the opening message for the President which was the National Perspective on Productivity. The keynote speakers were David Packard, Chairman of the Board, Hewlett-Packard; Andrew Grove, CEO, INTEL; Sanford McDonnell, CEO, McDonnell Douglas Corporation; and Senator Jeff Bingaman (D-New Mexico).



A U.S. Army researcher at NASA's Langley Research Center, Hampton, Va., aligns an advanced helicopter model prior to laser-assisted wind tunnel tests. Called a laser velocimeter, this relatively new research tool may help designers, predict helicopter rotor performance by unobtrusively measuring complex air flows in difficult-to-get-to places.

The model, as tested in Langley's 4 × 7 Meter Tunnel, represents one idea for an advanced army helicopter. The work is the first step in a cooperative effort between the Army's Rotorcraft Aerodynamics Office and NASA to develop a comprehensive rotor wake measurement and analysis program.

The research problem is complex. The rotor wake is embedded with a myriad of rotor blade tip vortices arranged in a helical pattern under the rotor system. The flow into the rotor system may appear to be relatively benign, but the inflow characteristics can be greatly affected by the rotor wake and its complexity.

Did You Know?

NASA's Ames Research Center, Mountain View, Calif., officially dedicated its newest research facility, the Fluid Mechanics Laboratory, in November of last year.

Ames scientists and engineers anticipate that this facility will stimulate breakthroughs in basic knowledge of aerodynamic flows. Important technological applications, ranging from developing fuel-efficient aircraft to low-speed research on the National Aero-Space Plane, will be addressed in the new lab.

The unique feature is that this new laboratory can support multiple, simultaneous small-scale wind tunnel research with full access to supercomputer resources for thorough analyses of theory and experiment.

A significant portion of the lab will be devoted to vortex flows. A major factor in the development of enhanced vehicle maneuverability and reduced drag by aerodynamic means is the use of effective vortex control devices. The key to control is the use of emerging computational tools for predicting viscous fluid flow in close coordination with fundamental experiments. In fact, these extremely complex flow fields require an intimate relationship between computation and experiment. Examples of current research in this area will be shown in the lab.

Researchers will be able to conduct experiments, get nearly real-time theoretical feedback and be able to alter the experiment to test a variety of configurations or test environments.

The $2.35 million, 21,336 sq. ft. facility houses small-scale wind tunnels for advanced experimental and computational research in fluid mechanics and will serve as a national focal point for government/industry/university cooperation. The wind tunnels will be supported with the most advanced optical and electronic instrumentation. The FML also will serve as a center for advanced computer/experiment integration by taking advantage of Ames' extensive computational resources.

Computer-operated precision tools capable of making finished cuts that are 60 times smaller than the diameter of a human hair are helping to support vital research projects at NASA Lewis Research Center.

The addition of computer numerical controlled (CNC) machine tools over the past dozen years triggered a need to update the technical training for the 30 already highly skilled modelmakers in Lewis' Machining and Metal Processing Branch.

Among the newer CNC machines are axis milling machines with a capacity to handle up to 10,000 pounds and the capability to perform five separate actions simultaneously. Altogether, there are 12 CNC machines available to manufacture everything from turbine blade airfoils, contoured inlet models, and compressor impellers to simpler hardware machinable with two and three axis machines.

All numberical programming is done by NASA Lewis personnel.

Of equal importance to the Machining and Metal Processing Branch was the acquisition of ultra-high precision machining capability three years ago.

There are three CNC lathes, eight CNC milling machines, and one CNC wire electrical discharge machine and a CNC electron beam welder in use by the branch.

Although today's emphasis is on CNC machining, conventional machining is still used to produce the majority of research hardware made at Lewis.

Conventional machine tools used include horizontal and vertical lathes — from jeweler's lathes to a 72-inch swing capacity with tracing features.

Grinding equipment includes tool and cutter, surface, cylindrical and centerless grinders and honing and lapping machines.

Milling machines range in size from small vertical ones to large horizontal spindle mills with 48″ × 60″ capacity.

Other equipment includes jig boring machines, vertical and horizontal shapers, heat treating furnaces, vacuum brazing furnaces, electron beam welders, dynamic balancing machines, airfoil milling machines and electrical discharge machines.

S. Milo Keathley, Chief Data Processing Systems Division, NASA's Johnson Space Center, Houston, Tx. received the General Services Administration's (GSA) new "Excellence In Administration" award honoring outstanding federal managers.

GSA Administrator Terence C. Golden presented S. Milo Keathley with a $7,500 check and a certificate of excellence.

Milo Keathley directs the data communications network that interconnects multiple data centers at the Johnson Space Center and across the country. The network that has evolved under his direction serves and interconnects multiple computer products as well as a wide variety of terminals and workstations. It allows access to the mainframes from both public and private data networks.

Delegates of the Inter-Agency Consultative Group pose with Pope John Paul II, in Rome Italy November 7, 1986 during a visit with him after their science meeting. The Pope commended the group for fostering more effective international collaboration in the space sciences. "A cooperation which can offer hope to men and women of science, as well as to all people of good will", he said. "The Church has great esteem for scientists, not only for their intellectual prowess, but also for their moral character, their intellectual honesty and objectivity, their self-disciplined search for truth, their desire to serve mankind and their respect for the mysteries of the universe which they explore." The Pope hopes that all scientists and engineers from the various countries continue to work together and thus merit to be called peacemakers. The Pope also stated how much he admires the contribution that NASA and others are making in the fields of science.

Government-Industry Executive Exchange

The President's Executive Exchange Program (PEEP) offers highly-selected employees from the private and federal sectors the opportunity to gain experience by crossing sector lines for a year. In addition to work experience, the participants are involved in an education program that consists of a 5-day September Public Policy Forum, a Spring 10-day International Study Conference, and a July 3-day Business-Government Relations Conference.

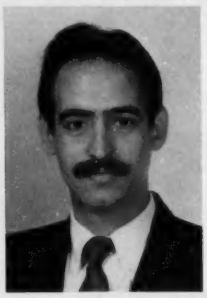
The program promotes mutual understanding between the federal and private sectors, fosters new and challenging experiences and stimulates ideas and promotes techniques which result in better management and greater cooperation. The aim of the program is to develop a cadre of experienced executives who will contribute unique insights and judgement in their policy-making positions.

Duncan McIver, Office of Aeronautics and Space Technology, was one of 12 federal executives selected for the 1985-86 program. He spent the year (Sept. 1985 to Sept. 1986) at Bechtel National, Inc. in San Francisco, Calif. researching new technologies for marketing applications. On November 24, 1986, he was appointed Director, of the National Aero-Space Plane (NASP) in the Office of Aeronautics and Space Technology, NASA Hdqtrs. His major responsibility is to be the NASA focal point for all NASP coordination, advocacy, resources management, technology oversite and program reporting activities. NASP is a joint program involving NASA and the Department of Defense.

For the 1986-87 program, NASA has three PEEP interchanges—one from NASA and two from industry.

John Wilson Gaff, Office of Management, is one of nine federal executives in the current (1986-87) program. His private sector assignment is with the Florida Power and Light Company. As a Senior Consultant, he works in the areas of long-range corporate planning, capital budget formation, and inventory resources systems development.

Elizabeth Rubin, from the IBM Corp., is one of 17 private sector executives assigned to federal agencies. She is Special Assistant to the Deputy, Associate Administrator for the Office of Space Flight, NASA Hqtrs. Her major area of responsibility is strategic planning. This includes the development of an integrated strategic planning process for OSF and the initiation of its institutionalization.



Jorge L. Viscaino, from the IBM Corp., is a Special Assistant to the Associate Administrator for the Office of Aeronautics and Space Technology, NASA Hqtrs. His major area of responsibility is strategic planning. This includes the development of an integrated strategic planning process for OAST in general, and more specifically, the strategic planning, policy formulation and program development for all aeronautics programs and their generic disciplinary research and technology.

Dr. James C. Newman, a senior scientist in the Materials Division at NASA's Langley Research Center, received the 1986 ASTM Award of Merit.

Newman received the award at a ceremony hosted by the ASTM Committee on Fracture Testing held in July in San Antonio, Texas. He was honored for distinguished service in advancing the voluntary standardization of test methods for fracture and fatigue-crack growth, and for dedicated service as chairman of a task group, secretary of the Subcommittee on Fracture Mechanics Test Methods, member-at-large of the Fracture Testing Executive Committee and as vice chairman of the Committee on Fracture Testing.

Lewis Research Center scientist Dr. James D. McAleese received NASA's high achievement award for helping to develop a standardized structural analysis system for the aerospace industry. The award includes a $1,500 stipend.

Called the NASA Structural Analysis System (NASTRAN), it is the specifications used throughout the aerospace industry for structural research on missiles and aircraft. McAleese was an original member of the ad hoc group that started work on the specifications 10 years ago.

McAleese heads Lewis' Dynamics Section of the Space Transportation Engineering Division that is responsible for conducting research on structures, loads and control problems associated with launch vehicles.

Ten Soviet Young Cosmonauts aged 14 to 18 visited the Kennedy Space Center as part of their 2-week stay in the United States. Accompanied by an official Soviet delegation, the young cosmonauts met with several school children from Central Florida high schools. This was the second phase of an historic exchange between American Young Astronauts and Soviet Young Cosmonauts which was agreed upon by President Reagan and General Secretary Gorbachev at the Geneva Summit in November, 1985. The American Young Astronauts visited the Soviet Union in October, 1986.

The NASA Teacher in Space Program Review and Evaluation Conference was hosted by the National Space Technology Laboratories Nov. 19-21. During the conference the Teacher in Space finalists took time to tour the National Space Technology Laboratories, Mississippi facilities, including the Space Shuttle test complex. Also participating in the conference was Dr. Robert Brown, Director of the Educational Affairs Division NASA Hdqtrs., and representatives of NASA's educational programs. Teacher in Space finalists, pictured from left, are Barbara Morgan, Dick Methia, Kathleen Beres, Peggy Lathlaen, Judith Garcia, Dave Marquart, Robert Foerster and Niki Wenger. Michael Metcalf did not attend.

COBE To Be Launched On Delta Rocket

NASA announced plans to launch the Cosmic Background Explorer (COBE) satellite on a Delta expendable launch vehicle rather than the Space Shuttle. This decision will further NASA's effort to pare the backlog of science payloads that cannot be accommodated on a timely basis by the Shuttle.

The COBE, designed, integrated and tested at NASA's Goddard Space Flight Center, Greenbelt, Md., will be launched into a 560-statute-mile, sun-synchronous orbit from Vandenburg Air Force Base, Calif., in early 1989.

Carrying three scientific instruments, COBE is designed to study the "Big Bang", the primeval explosion that started the expansion of the universe 15 billion years ago.

Originally scheduled for deployment from the Space Shuttle in July 1988, COBE is one of several science payloads awaiting launch as a result of the Challenger accident and the decision to defer activation of the West Coast Shuttle launch site until the early 1990s.

Flight Crew Announced For Next Shuttle Mission

Rear Admiral Richard H. Truly, NASA Associate Administrator for Space Flight, announced the flight crew for Shuttle mission 26, now targeted for launch on Feb. 18, 1988.

The mission will be commanded by Frederick H. Hauck (Captain, USN). Hauck previously commanded mission 51-A in November 1984 and served as pilot on STS-7 in June 1983.

Richard O. Covey (Lt. Col., USAF) will be the pilot on this mission. Covey served as pilot on flight 51-I in August 1985.

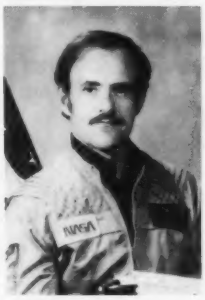
Mission specialists for the mission will be John M. Lounge, who flew as a mission specialist on flight 51-I; George D. Nelson, who served as a mission specialist on flights 41-C in April 1984 and 61-C in January 1986; and David C. Hilmers (Major, USMC), who flew as a mission specialist on flight 51-J in October 1985.

In announcing the crew, Adm. Truly said, "The naming of the crew for the next flight is a major event in the process of returning the Shuttle to flight. I am particularly pleased to assemble a group of such experienced individuals led by one of our senior spaceflight veterans, and I am very proud of them."

The Shuttle Mission 26 Crew

Frederick Hauck
(Commander)

Richard Covey
(Pilot)



John Lounge
(Mission Specialist)

George Nelson
(Mission Specialist)

David Hilmers
(Mission Specialist)

Contractor News

NASA signed an agreement with the **3M Corp.,** St. Paul, Minn., to conduct 62 materials processing experiments aboard the Space Shuttle over an extended period.

Signed by NASA's Assistant Administrator for Commercial Programs, Isaac T. Gillam, the Joint endeavor agreement will provide the 62 flight opportunities for the purpose of conducting materials processing in space experiments in the areas of organic and polymer science, areas in which 3M specializes and has major interests.

NASA will schedule the 3M experiment flights on a space available basis. The assignment of specific experiment flights will be contingent upon negotiation of individual task agreements which contemplate a particular 3M research project in a specific scientific area over a specified number of Shuttle flights.

Under the agreement, NASA will have use of 3M's experiment apparatus for its own scientific investigations, subject to certain limitations, and 3M is not provided with exclusivity of any type.

NASA selected **McDonnell Douglas Astronautics Co.,** Kennedy Space Center, Fla., for negotiations leading to the award of a contract to perform Payload Ground Operations at Kennedy, including KSC activities at Cape Canaveral Air Force Station, Fla.; Vandenberg Air Force Base, Calif.; Space Transportation System landing sites and work locations in or outside the United States.

The PGOC is a consolidation of work presently being performed under contracts with McDonnell Douglas, Boeing Aerospace, Computer Science Corp., EG&G Florida and Planning Research Corp.

The cost-plus-award-fee contract will have an initial period of 3 years, plus a single-price option for an additional 3 years. Ultimately, follow-on awards could result in a total contract period of 15 years. McDonnell Douglas' proposed cost for the first 6 years is approximately $327 million. The contract will be managed by Kennedy Space Center.

The purpose of the PGOC is to obtain a single, long-term contract for payload processing activities. The contractor will perform the activities necessary for payload/cargo processing and integration; Spacelab operations and integration; support to experiment integration activities; payload/cargo deintegration; NASA/Vandenberg payload operations; payload related facilities, systems and ground equipment operations; maintenance and sustaining engineering customer accommodation and launch-site support functions; and payload related support operations and services.

The NASA Lewis Research Center, Cleveland, Ohio, awarded parallel contracts to design an advanced power system which holds promise for providing highly efficient, long-life and reliable dynamic power systems for future terrestrial applications. This work also may have applications to NASA's research on future space power systems.

The design will include a free-piston Stirling engine, a liquid metal heat pipe receiver, and a means to provide power to a utility grid.

Contracts were awarded to **Mechanical Technical, Inc.,** Latham, N.Y. ($253,385) and **Stirling Technology Co.,** Richland, Wash. ($246,576).

Research on the Advanced Stirling Conversion System is funded by the Department of Energy (DOE) Solar Thermal Technology Program. NASA's Lewis Research Center, with substantial background and expertise in Stirling engines, is providing technical management, and Sandia National Laboratories, Albuquerque, New Mexico, is managing the program.

The free-piston, external combustion Stirling engine has only two moving parts and works by heating and cooling air or a gas enclosed in a cylinder. At one end of the cylinder, a heat source, such as focused solar energy, heats the air or gas inside the cylinder. As the gas is heated, it expands and pushes the piston. Electric power to the utility grid is derived from the engine either directly, using a linear alternator, or indirectly by use of a hydraulic output to a ground-based fluid pump coupled to a generator. The conceptual designs will have the potential of meeting DOE's long-term performance and cost goals.

NASA's Marshall Space Flight Center, Huntsville, Ala., selected **Computer Sciences Corp./Pan Am World Services,** Falls Church, Va. for negotiations leading to award of a 10-year contract to operate a space agency computer facility.

The contract will call for the management, operation, maintenance and protection of Marshall's Slidell Computer Complex, Slidell, La. The facility provides computer services support primarily to Marshall's Michoud Assembly Facility, New Orleans, which manufactures external tanks for the Space Shuttle.

The company will provide the necessary personnel, equipment and supplies to carry out its duties. The contract has an initial period of performance of 1 year, beginning in February 1987, and will contain nine 1-year options. The approximate, proposed value of the 10-year contract will be $99 million.

WORK WEEK

SUNDAY

MONDAY

TUESDAY

WEDNESDAY

THURSDAY

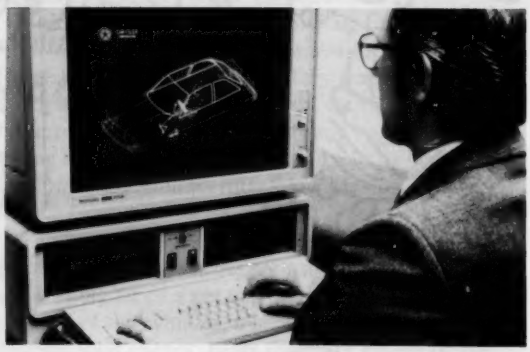
FRIDAY

SATURDAY

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Auto Design



For Chrysler Corporation, computer technology is an integral part of all automobile manufacturing operations. The corporation's operations are supported by one of the world's largest computer systems—16 mainframe computers, processing 464 million instructions per second, connected to 700 terminals.

One phase of Chrysler's work is illustrated in the photo, which shows a computer-aided design system used to create vehicle body designs, including panels, steering geometry, suspension and other systems. The imagery pictured was part of a seating study for the Chrysler LeBaron GTS.

One of the computer design tools employed by Chrysler engineers is a computer program developed by NASA's Lewis Research Center, Cleveland, Ohio. Called SPAR (Structural Performance and Design), it is used to optimize the design of the outer body panels of Chrysler cars and trucks. SPAR's advantages are that it is interactive, easy to use and fast. It is used to solve relatively small problems when quick response is important; other programs provide the necessary structural analysis for large problems.

SPAR was supplied to Chrysler by NASA's Computer Software Management and Information Center (COSMIC), which routinely provides to industry and government customers software packages that can be adapted to uses other than those for which they were originally developed by NASA and other technology generating agencies of the government. COSMIC maintains a library of some 1,300 programs applicable to a broad spectrum of business and industry operations.

* NASA does not endorse commercial products developed as a reulst of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.